INTRODUCTION

Health and nutrition are the two contributory factors for the human resource development of any country. Nutritional Status of adults is of particular importance since it is the adult group that is primarily responsible for rendering economic support to the society as a whole. Adults play a pivotal role in the overall progress of a country as they constitute the major chunk of human resources of a nation.

The tremendous socioeconomic developments over the past thirty years has resulted in unprecedented economic affluence which has brought about drastic changes in the life style of the Indian communities especially in food consumption patterns and undesirable lifestyle alterations. A country's wealth and prosperity are seriously and adversely affected when the nation's human resource is neglected. India faces a double burden: people belonging to lower socioeconomic group are predominantly underweight, while those from higher strata are obese. The last few decades have seen a remarkable transition in Kerala. Kerala is at the high end of nutrition transition while other parts of the country are only slowly moving up. The state is fast emerging as the life style diseases capital of India with the prevalence of hypertension, diabetes, obesity and other risk factors for heart disease, reaching levels comparable to the developed countries.

Analysis of data and identification of risk groups and causative factors is essential for prioritization and development of various strategies for prevention and control of malnutrition. For a valid picture of a population's nutritional profile we need to have precise information on the distribution of a population according to nutritional status. Kochi being the most thickly populated commercial capital of Kerala having about 58% adult population was selected for the present study. The situation in Kochi can reasonably be expected to repeat today or tomorrow in other parts of the state.

Keeping BMI as the central measurement for health and well being its socioeconomic, anthropometric, energy balance and body composition correlates could throw more light on the feasibility of BMI as the quick measurement at field level. The broad objective of this study was therefore to identify the correlates of BMI and the relationship between BMI, energy balance and body composition

among the adult population in Kochi. The specific objectives of the study were to;

1) Assess the nutritional status of adults (18-60 years) in Kochi Corporation in terms of Body Mass Index (BMI).
2) Study the various correlates of Body Mass Index in the selected population.
3) Elicit information on the energy balance and body composition of selected male and female adults in terms of their BMI.
4) Evaluate various BMR predictive equations in relation to BMI in the selected sub sample.
5) Develop a user friendly software package for Kerala population to create nutrition and health awareness among them.

METHODOLOGY

Kochi Corporation in the Ernakulam district was the area selected for the conduct of the present study. It has a population of 5, 96,473 of which 58.53% i.e. 3, 49,116 are adults. Increased percentage of adult population provides the corporation an opportunity to rapidly improve the health and nutritional status of the citizens and to optimally utilize these available human resources.

A total of 2500 subjects including male and female subjects in the age group of 18-60 years and who had consented formed the population for the study. It was a cross sectional study, carried out by adopting multistage stratified random sampling method. Of the 72 wards, 25 wards were selected, and from each ward 100 subjects were randomly selected. Subjects were screened for height and weight from which BMI was calculated.WHO (2004) classification was used to categorise the subjects. Purposive sampling was adopted for an in-depth study on the energy balance and the body composition pattern of adults in relation to the category of BMI. A total of 420 adults, who were willing to subject themselves for all the protocol involved for the in-depth study, formed the sub sample. Care was also taken to see that both male and female subjects fell into two categories based on age i.e. early adulthood 18-29 years and late adulthood 30-60 years as classified by ICMR (1989).

An interview schedule was developed and information on the demographic profile, age, height and weight was collected by the investigator through visits to each household individually and BMI was calculated from the data on height and weight. For the in-depth study a questionnaire was developed and used to collect information from the sub sample (420 adults) on socioeconomic status, motivating and demotivating factors on food intake, physical activity, energy intake (24 hour recall) and energy expenditure(24 hour activity diary). For the subsample (420 adults) apart from height and weight, various circumferences at mid upper arm, waist, hip and skinfold thickness at biceps, triceps, subscapula and suprailiac were also recorded.

Energy intake was calculated by using 24 hour dietary recall method. It was interpreted using nutritive value of Indian foods (ICMR, 2010). Taking into account that physical activity and eating habits may vary on some days of the week, a period of two working days and one holiday was used while collecting information on energy intake and expenditure. Energy expenditure on physical activity was determined from Physical Activity Level (PAL) where the PAL was determined by a questionnaire containing daily activity record. For this, the number of minutes spent by the subject on each activity was recorded for a period of 24 hours. The PAL was calculated by assigning physical activity ratios (PAR) of FAO/WHO/UNU (2002) to these activities. The PAR is the ratio that expresses the energy cost of an individual activity per minutes, as multiples of BMR. A modified equation applicable to Indians as derived by ICMR (1989) was used for predicting BMR (Kcal/24hr) in the present study.

An attempt has also been made to investigate the association between body fat percent and fat free mass percent of adults of different BMI. In the current study fat free mass was determined only through anthropometry. Percent body fat was calculated from sum of skin fold measurements (Durnin and Womersley equation 1974), body density (Siri's equation 1961), body fat percent from predictive equation using body mass index (Duerenberg et al. 1991),predictive equation for Indians (Goel 2008) and Bioelectrical Impedance Analysis (BIA).

During the course of the present study it was felt that there is a need to have novel public health strategies such as computer based health education remedial measures, about life style changes and dietary modification in order to promote a healthy lifestyle among the population under study. Methodology of the software was developed in a user-friendly procedure as a ready reckoner for BMI, physical activity level, BMR, energy intake, energy expenditure and overall energy balance to motivate adult population for self monitoring. It was named "CALEBOR '' based on amalgam method of naming by taking parts of words and putting them together (cal/orie and e/nergy b/alance or/ganiser).

Evaluation of the software was established through testing its reliability and validity. Reliability was established by Test-Retest and Parallel method. Likert scale was used to indicate the agreement or disagreement on the statements regarding the software.

The major findings are;

- Of the 2500 adults selected 1128 (48.5%) were male and 1288 (51.5%) were female. Our data from Kochi Corporation showed the preponderance of Hindu population (47.5%) followed by Christians (38.4%) and Muslims (13.8%). Regarding educational level majority were well educated i.e. 38.3 percent were graduates, 38.9 percent were post graduates. Only five percent had education below SSLC and none of the subjects were illiterate. Monthly income of majority (61.3%) of the subjects was between ₹10,000- ₹ 30, 000, followed by 22.4 percent who had income between ₹ 30,000 - ₹ 50,000. A small proportion i.e.2.6 per cent had income above ₹ 50,000.
- Nuclear families predominated (55.2%) in comparison with joint families (41.8%). The distribution of respondents by natives and migrants showed that 56.8 percent were natives of Kochi where as the rest 43.7 percent constituted migrants from other places. Majority of the selected subjects (61.5%) belonged to sedentary activity category, whereas 34 percent were in moderate category and only 4.5 percent were engaged in heavy activity.

- A mean height of 172.2 cm was recorded for the male subjects and the height was maximum (174.5cm) in the age of 25- 34 years after which there seems to be a decline; while for female the mean height was lower i.e. 158.7cm and it was found to be maximum (160.5cm) in the age of 25-34 years and decreased as age progressed. The mean weight of the adult male and female were 73.1 kg and 58.9 kg respectively. It was observed that among female weight was directly proportional to age.

- Body Mass Index data showed that, prevalence of underweight (BMI <18.5) was 0.7 percent among male and 11.6 percent among female. Severe thinness was absent in male but was seen among 0.9 percent female. It was noticeable that the overall prevalence of overweight/Obese (BMI > 25) was higher among men (44.2%) than among women (33.0 %), among them 3.9 percent of male and 4.0 percent female were obese(BMI >30). Only 55.1 percent of men and 55.4 percent of women were found to have normal weight (BMI between 18.5 and 24.9). Among both men and women studied there was a higher percentage overweight/obese category and underweight which points out the dual burden of malnutrition faced by Kochi population.

- In order to explore the contributions of socio economic factors towards the prevalence of the double burden of malnutrition, association between nutritional status of adults and socioeconomic variables were studied. Pearson's Chi-square test showed that there is a close association between BMI and age ($\chi 2$=623.765). As age advances prevalence of underweight and normal weight decreased from 19.1%to 1.1% and 70.9% to 33.1% respectively, whereas overweight and obesity found to increase from 9.5 to 54.5% and 0.6% to 11.3%. Z- test for ratios further revealed that there existed a significant difference in the occurrence of different BMI across different age groups.

- Nuclear families have more number of normal weight adults (58.4%) compared to joint families (50.9%). Underweight as well as overweight/ obesity were high in joint families. Chi-square test for independent attributes was carried out for the type of family versus BMI of the

subjects which showed significant association ($\chi 2$=19.899). From Z test for ratios it could be concluded that there existed a significant difference in the proportion of normal weight, overweight and obese in joint and nuclear families, but there was no significant difference observed in the proportion of underweight adults in joint or nuclear families.

- Prevalence of obesity was slightly higher among the female (4.0%) compared to male (3.9%). However, overweight was higher among male (40.3%) compared to female (29.0%). Percent of normal or optimal BMI was similar among men (55.1%) and women (55.4%). But underweight was more prevalent among women (11.6%) compared to men (0.7%). Chi square analysis ($\chi 2$= 141.845) showed that body mass index and sex are closely associated. Further observations with Z test among the present study population showed that there was a significant difference in the proportion of male and female in underweight and overweight category but no significant difference among normal and obese subjects.
- BMI profile of people residing at different areas of the Corporation showed variations. Prevalence of overweight was highest in rural areas (41.1) compared to urban (32.4%) and coastal (24.8%). Coastal area had better BMI profile as 75.2 percent had optimal body mass index followed by urban 56.8 percent and rural 43.8 percent. It was interesting to note that in coastal areas none of them were underweight. Urban had 9.5 percent underweight and in rural it was 6.2 percent. Overall it was seen that the proportion of overweight exceeded underweight in all the areas studied (rural, urban and coastal areas). Statistical analysis ($\chi 2$ = 173.69) showed that BMI was significantly associated with place of residence. Z-value showed significant differences in the proportion of underweight, normal weight, overweight and obese adults belonging to different residential areas namely urban, rural and coastal.
- There was a distinct difference between the BMI profiles among different religions. Prevalence of overweight was almost equal among Muslims (37.3%) and Christians (36.9%) compared to Hindus (31.7%). Underweight was more prevalent among Hindus (7.1%) followed by Muslims (6.7%)

where as it was the lowest among Christians (5.1%). Chi Square analysis ($\chi 2 = 23.712^{)}$ showed that there was significant association between religion and BMI. Z test for ratios showed that there existed a significant difference in the proportion of obese in Hindus and Muslims and Christians and Muslims. In the case of normal weight there existed a significant difference between Hindus and Muslims and for overweight Hindus and Christians. All the others were not significant.

- Maximum number of normal weight subjects was found among graduates and post graduates. There was an inverse relationship between level of education and incidence of obesity. On the contrary, the percentage of under weights was highest among the graduates. In this study, a significant association was found between the level of education and BMI ($\chi 2 = 109.705$). On the whole, the Z value computations supported the fact that well educated subjects had better nutritional status.

- Majority of the 'heavy workers" (68.7%) had normal weight, whereas only 60.1 percent and 51.7 percent "moderate" and "sedentary workers" had normal weight. On the other hand only 25.0 percent and 0.9 percent of heavy workers belonged to overweight and obese category respectively. A higher percentage of overweight 35.5 percent and obese 5.1 percent were observed among the sedentary activity adults.Statistical analysis ($\chi 2=41.551$) showed that BMI and type of occupational activity were closely associated. It was felt true that in the modern society inactivity or low level of physical activity combined with changes in eating habits are the main reasons for the prevalence of overweight or obesity

- There is a relationship between income and BMI except for subjects with income above ₹ 50,000. The percent overweight people increased along with their income where as the percent normal weight declined as income level increased. Statistical analysis ($\chi 2= 49.117$) also showed a significant association between BMI and family income. Further statistical analysis (Z-test) revealed that among normal weight, overweight and obese adults there was significant difference between income groups but did not show any

significant difference in the proportion between any income levels among underweight subjects.

- An in-depth study was undertaken on the energy balance and body composition pattern of adults with different BMI category. To investigate the possible association between the energy consumed at different meals and BMI, the investigator analyzed the nutrient intake data of the adults as per BMI. It was seen that the total energy intake increased as BMI increased with underweight having minimum and overweight subjects having maximum intake. It was also noticed that the energy obtained from in-between meals / snacks was almost equal to that of main meals in the case of overweight subjects.
- Subjects of all BMI categories agreed that a desire to eat was the strongest motivating factor to consume food .Taste seems to be the second factor that influence food intake. Advertisements and availability of commercial foods do not seem to influence adult choices of food intake. For underweight subjects, lack of taste sensitivity was the strongest demotivating factor, where as for normal weight depressed feeling (emotional factor) and for overweight subjects it was the feeling of satiety. Cost of the food and depressed feeling had least influence to reduce food intake among underweight as well as overweight subjects. Normal weight subjects ranked least for lack of taste sensitivity and depression as the demotivating factors.
- The total daily energy expenditure (TDEE) of underweight, normal weight and overweight male was 1884 Kcal, 2428 Kcal and 2327 Kcal respectively and of their female counterparts the respective values were 2182 Kcal, 2304 Kcal and 2552 Kcal. Male had lower TDEE compared to their female counterparts among underweight and overweight adults. BMR increased steadily as BMI increased. Lower BMR was observed in female compared to male. BMR differs for men and women.
- The energy spent on physical activity of the underweight and overweight male adults was considerably lower than that of their counter parts in

normal weight male subjects. The underweight female had energy expenditure on physical activity comparable to that of normal weight adults. It is noticed that the cost on physical activity is less in male than in female except in the case normal weight adults. Reduced physical activity along with increased energy and fat intake may be responsible for the increased prevalence of overweight in the selected adult population.

- Female had higher Physical Activity Level (PAL) compared to their male counter parts. PAL did not show a trend of increase with increase in BMI. Based on PAL all of the overweight male (100%) and 82.86 percent females in overweight category were sedentary (PAL <1.69). The mean PAL showed a sedentary lifestyle for all groups except underweight female. Only 2.9 percent and 4.3 percent of male in under weight and normal weight category and 34.3 percent, 28.6 percent and 17.1 percent female of underweight, normal weight and overweight respectively were active(PAL 1.7-1.99). Only a small proportion were vigorously active(PAL 2- 2.4) Comparison among BMI strata shows that proportion of female who are active are higher in comparison to their male counter parts. It was also noticed that overweight persons had the lowest physical activity levels in terms of their PAL.
- Irrespective of BMI category adults spent approximately 8 hours on sleeping and maximum time on other activities (9.8-11.2 hours/ minutes). Among the three BMI categories underweight subjects expended maximum time on occupational activities (male 5.6 hours/minutes; female5.9 hours/minutes).Underweight subjects ranked physical activity as a form of relaxation, whereas normal weight and overweight adults ranked physical activity to be the best for management of health. Underweight and normal weight subjects felt lack of time as the most important barrier for performing physical activity. For overweight subjects fatigue followed by lack of time were the demotivating factors.

- The mean energy balance exhibited great variation in each BMI groups. Underweight adults were found to be on negative energy balance (-808 Kcal and -1102 Kcal for male and female) and overweight subjects (+517 Kcal and +331 Kcal for male and female) exhibited a positive energy balance. Statistical analysis using‘t’ test showed significant difference between energy intake and expenditure among underweight adults (negative balance) and overweight subjects (positive balance). Normal weight adults were found to be on negative energy balance (-72 Kcal and - 180 Kcal for male and female respectively), but the difference between energy intake and expenditure was statistically significant only among the females.

- Energy intake was significantly and positively correlated with BMI (r= 0.794; $P < 0.01$) as per the Pearson’s correlation coefficient. As per Pearson’s correlation coefficient Physical Activity Level (PAL) and TDEE had no significant relationship with BMI. Energy balance found to have strong and positive relationship with BMI(r =O.719, $P < 0.01$).

- An attempt was made in the present study to compare the BMR calculated using equations proposed by ICMR(for general Indian population), equation derived for international use (FAO/ WHO/UNU Equations) and those equations proposed by Kurian et al. for Indian male and female subjects belonging to different BMI. There seemed to be a great variation in the BMR obtained from the ICMR, FAO/ WHO/UNU and Kurian et al. equations among the male and female subjects in all BMI groups, with wide variations for female subjects.

- The mean value of waist circumference (WC)was found to increase as Body Mass Index increased .All of the underweight male and female subjects were in normal category based on waist circumference. In the case of normal weight subjects 97.1 per cent of the male and 65.7 per cent of female subjects had waist circumference in the normal range, indicating that 2.9 percent men and 34.3 percent women were in the high risk group. In the case of overweight subjects 50.0 per cent of male and 88.6 per cent of female were found to be in the increased risk category

out of which 78.6 percent of women were at high risk. There was a significant association between waist circumference and BMI (F=324.8 p <0.01). Waist Circumference also showed significant positive correlations with BMI (r=0.861; P < 0.01). Therefore, waist circumference could well add extra information to BMI for adults in body composition assessments.

- In both men and women waist hip ratio(WHR)increased in accordance with BMI. Based on WHO(2011) criteria for WHR even underweight subjects, 12.9 percent of male and 1.4 percent female exhibited central obesity (>0.9 for males and >0.85cm for females). Among normal weight subjects, 22.9 percent of the male and 37.1 percent of the female subjects showed abdominal obesity. Among overweight subjects 84.3 per cent of both male and female had abdominal obesity. There was a strong association between BMI and WHR (F=122.82 p <0.01). BMI and WHR showed positive correlation (r=0.538; P<0.01) but was the weakest correlation among the other anthropometric parameters studied.
- The mean mid upper arm circumference (MUAC) of male underweight normal and overweight subjects were 24.7±3.1cm, 30.7±.3.6cm, and 32.4±2.9cm respectively and that of respective female were 22.3±1.4 cm, 27.5±5.4 cm, and 30.6±5.0cm. Male had higher MUAC compared to female. Mid upper arm circumference was found to increase with Body Mass Index. Statistical analysis showed positive association between BMI and MUAC (F= 148.589 p <0.01). BMI was significantly and positively correlated with MUAC (r= 0.740; P < 0.01) as per the Pearson's correlation coefficient.
- All the four skinfold measurements among both male and female showed a steep rise as per increase in BMI. Females had greater skinfold compared to male counterparts. All the subgroups had a higher skinfold in the late adult hood (30-60 yrs) compared to early adulthood. Higher skinfold measurements in subjects may be attributed to the higher body fat. All the four skinfold values were found to be significantly and positively associated with BMI, however the highest correlation was found to be with suprailiac (r=0.856 P < 0.01).

- Mid upper arm area (MUAA) values of male showed wide variation ranging from 49.2cm^2 underweight followed by 76cm^2 in normal weight and 84.4 cm^2 in overweight subjects. For female counter parts the values were39.6 cm^2, 62.4cm2 and 76.5 cm^2 respectively. Mean MUAA increased steadily with the increase in BMI. The MUAA of male were higher than that of female. Except for the male underweight mid upper arm area increased as age advanced in all BMI categories.
- Male underweight subjects had lower mean mid upper arm muscle circumference (MUAMC) 22.2±3.5cm than normal weight subjects 26.4±3.2 cm and overweight 23.9±3.5cm subjects. A similar trend was seen among female also with lowest 19.5±1.5cm recorded for underweight, 22.6±5.6cm for normal weight and 22.0±4.5cm for overweight. Subjects having optimal BMI had the highest mid upper arm muscle circumference.
- Male had higher mid upper arm muscle area (MUAMA) than female. Arm muscle area of male ranged from 40.3cm^2, 56.3cm^2 and 46.4cm^2 for underweight, normal weight and overweight respectively. For females lower mean mid upper arm muscle area was found in underweight (30.6cm^2) followed by normal weight 43.0cm^2 and overweight 40.0cm^2.Except for underweight male arm muscle area increased as the age increased. In both normal weight male and female increase in muscle area markedly increased as age increased.
- Corrected arm muscle area (CMUAMA) was lower in female compared to male. The mean value was highest for normal weight male (46.3cm^2) compared to underweight (30.3cm^2) and overweight (36.4cm^2) subjects. Female also showed a similar variation with highest value for normal weight (36.5cm^2) followed by overweight (33.5cm^2) and least for underweight (24.1cm^2) subjects. Arm fat index of underweight, normal and overweight male subjects was found to be 19.1, 25.8 and 44.6 percent and of their counterpart female it was 22.7, 33.1, and 48 per cent respectively. In general female had higher arm fat index compared to male.

- Positive and significant correlation was obtained between BMI and mid upper arm area (MUAA) (r=0.561; $P < 0.01$) based on Pearson's correlation coefficient. The mid upper arm fat area (MUAFA) (r=0.853; $P < 0.01$) and arm fat index (AFI) (r=687; $P < 0.01$) also had significant association with BMI. There was no significant correlation obtained with the indicators of skeletal mass such as mid upper arm muscle circumference (MUAMC) (r=0.252), mid upper arm muscle area (MUAMA) (r=0.250) or corrected mid upper arm muscle area (CMUAMA) (r=0.258).

- Mean Percent Body Fat (PBF) obtained from various methods namely sum of skinfold measurements, body density by Siri's Equation, Deurenberg (1991) Equation for Asian Adults based on BMI, Goel et al. (2008) predictive equation for Indian adults and Bio Impedance Analysis (BIA) were determined and compared with reference values of American Dietetics Association (ADA) and National Institute of Health/WHO. Mean body fat percent of males were 13.6±1.7, 22.9±3.4 and 30.9±4.1 of underweight, normal weight and overweight subjects respectively and for females the respective values were 20.9±1.9, 31.1±1.9 and 39.0± 4.0 . Overall skinfold method gave higher fat percent compared to other methods. There was a direct proportion between BMI and percent body fat; at higher BMI percent body fat was also high for both male and female. Female had higher percent body fat than men. Despite their lower BMI (<18.5) underweight subjects had PBF within the accepted range, where as normal weight and overweight subjects exceeded the ideal values. Therefore it underscores the findings that even at lower BMI body fat percent of Indians are high compared to other populations (WHO 2004).

- Composition of the body is basically divided into two components, fat and fat free mass. The mean fat mass was 6.57Kg (13.6%), 14.63 Kg (22.9 %), and 23.48 Kg (30.9 %) for underweight, normal and overweight men respectively. For women respective values were 9.03Kg (20.9 %), 16.91 Kg (31.1 %), and 25.78 Kg (39.0 %). Percent lean body mass of men were 86.4%, 77.1% and 69.15 for underweight, normal

weight and overweight whereas for respective women it was 79.1 %, 68.9% and 61.0%. Women were found to have higher fat mass than men and percent body fat increased in relation to BMI category. Percent fat free mass was found to decrease as BMI increased. The BMI was found to be highly correlated with body fat percent($r = 0.823$, $p < 0.01$).Body fat percent obtained by all the five methods were found to be significantly and positively correlated with BMI .Among these the one by Goel's equation was found to be highly significant ($r = 0.854$, $p < 0.01$).

- A ready reckoner of energy balance for the target population namely CALEBOR was developed as an application software package for the target users. Reliability of the new software "CALEBOR" was established by Test-Retest and Parallel method. No variation was observed on repeated trials in the Test – Retest or parallel test on Body Mass Index and Basal Metabolic Rate. However there were slight changes observed in energy intake and expenditure at each trial. Statistical analysis by Student's t- test showed that the differences were insignificant. On the whole it could be presumed that the results obtained with CALEBOR were reproducible and consistent, indicating its reliability. To test the validity the new software named CALEBOR was also evaluated by 10 nutrition experts and then field tested with 20 male and female adults belonging to Kochi in the age group of 18-60 years. Overall the programme was rated at 84 % agreement with nutrition experts and 85.3% agreement with target users and thus found acceptable.

CONCLUSIONS;

To sum up, 44.7 percent of the adult population in Kochi faces a double burden of malnutrition in which 34.5 percent were overweight /obese and 6.3 percent were underweight. Another important finding is that men are more in the category of overweight than women and also that women are more physically active than their male counterparts. The mean PAL estimate showed that the entire population except underweight female led a sedentary lifestyle. Undoubtedly there

is an inverse relationship existing between physical activity and increased prevalence of overweight.

All correlates namely socioeconomic, anthropometric, body composition indices and components of energy balance positively correlated with BMI. But MUAMC, MUAMA, CMUAMA, PAL and TDEE did not show any significant correlation. Many researchers are of the opinion that BMI may not adequately measure malnutrition at both levels of undernutrition and overnutrition, the data obtained from and analysed in this study establishes significant association with various correlates of BMI. Body Mass Index can thus be the pivotal point in determining the percentage undernutrition and overnutrition at the field level.

Current socioeconomic scenario denotes that the food intake has increased disproportionately but physical activity has gone down dangerously. Previous studies have reiterated the connection between BMI and total energy intake. In the present study also similar observations were made. It is perceived that health strategies must be tailored to reduce intake of high caloric food with maximum complex carbohydrate intake with optimal levels of energy from fat and protein coupled with improved physical activity to reverse the current frightening and alarming trend in overweight and obesity which leads to higher levels of NCD now prevalent in the community.

As per the international standards the BMI cut off for normal weight is fixed at 25.However it seems to be inapplicable to Kochi population in particular and the Indian population at large. Hence research to redefine BMI cutoffs for Indian population should be the priority, so as to alert the consumers to avoid the trend towards high lifestyle diseases.

Strategies to improve the socio-cultural and environmental conditions along with nutrition awareness can go a long way to tackle the issue of malnutrition at all levels namely individual, community and policy levels. Strategies at individual level must be evolved so as to instill the dangers of wrong diet and adopt intelligent eating i.e. eating at right time, the right food, in the right proportion at right intervals. A reassessment of leisure activities would help them to replace sedentary

entertainment modes to physical activity oriented games. A true perspective of the media would help to avoid junk and calorie dense foods.

Interventions using the present day technology will help individuals and communities to learn about nutrition and health. Nutritionists and health workers should develop appropriate web based intervention strategies to cover the primary areas of concept of health that will be suitable for different age groups. As far as the community is concerned the local clubs, resident associations and social and religious institutions would enhance the scope of physical activity through health clubs, safe and secure walking strips and by displaying point of decision prompts (signs) near lifts and escalators to encourage walking. Policy and environmental strategies include reducing the cost of healthy foods; expand opportunities for physical activity for all like recreational facilities, parks, playgrounds, sidewalks, bike paths and safe streets in neighborhoods. Banning unhealthy food marketing to children in the school premises, compulsory daily physical education and recreation in school is essential. The subject of nutrition and physical fitness may be incorporated in the school curriculum to make the children aware of the dangers in store resulting from wrong diet and lack of physical activity. Qualified nutritionists may be appointed in institutional canteens and eating places like schools, hospitals and industrial establishments to assure that a balanced diet is served as per their requirement. Well qualified and experienced nutritionists must form part of all policy decisions at the Government level.

As early as BC 428- 347, the great Greek philosopher Plato has foreseen that the relationship between good health and physical activity will pave the way to preserve well being and proclaimed that; “Lack of activity destroys the good condition of every human being, while movement and methodical physical exercise saves it and preserves it.”